AIRO

Report No. L/3508

for
Buzzispace
Groeningenlei 141
2550 Kontich
BELGIUM

Dated: 14 October 2020

LABORATORY MEASUREMENTS

OF THE

SPEECH LEVEL REDUCTION

OF

BUZZINEST BOOTH

Report Author: M Sawyer MIOA

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LABORATORY MEASUREMENTS

OF THE

SPEECH LEVEL REDUCTION

OF

BUZZINEST BOOTH

1. INTRODUCTION

This report presents the results of measurements made in the AIRO Acoustics Laboratory of the Speech Level Reduction of BuzziNest Booth.

The measurements were made on 22 September 2020 for Buzzispace.

Measurements to determine the Level Reduction (D) of a booth were conducted in accordance with International Standard ISO 23351-1:2020 (ref 1). Single figure ratings of sound insulation performance, known as the Speech Level Reduction ($D_{S,A}$) and Class, are derived from these measurements in accordance with Reference 1.

2. SUMMARY OF RESULTS

The results of the measurements presented in this report are summarised in the following table:

AIRO Test No.	Test Specimen	$D_{S,A}$ (dB)	Class
L/3508	BuzziNest Booth	27.1	B

Approved by:

D L Watts

Eur Ing D L Watts BEng CEng FIOA
Principal Consultant

Report Author:

M Sawyer

M Sawyer MIOA
Laboratory Manager

3. TEST SPECIMEN DETAILS AND CONDITIONS

It shall be noted that the results in this report relate only to the specimen as received for test.

The specimen was delivered and installed for test by Screen Solutions Ltd on 22 September 2020 with the selection of the components for test made by Screen Solutions Ltd.

Screen Solutions Ltd has supplied drawings of the test specimen which AIRO considers to be accurate. The following description has been produced by AIRO from its observations.

3.1 BuzziNest Booth

AIRO Test No. L/3508

The test specimen comprised a BuzziNest Booth telephone privacy pod. The fabric covered BuzziNest Booth, with external dimensions of 1098 mm wide x 1046 mm deep x 2177 mm high, and a footprint of 1007 mm wide x 1046 mm deep, comprised a timber famed construction with felt internal and external sound absorbent panels. The front wall comprised an 8.8 mm acoustic laminate glass door with a magnetic latch which closed onto a soft seal. The rear wall of the Booth also comprised 8.8 mm acoustic laminate glass. The Booth included a carpet, and an approximately 0.47 m cube shaped seat. The Booth also included a ceiling mounted lighting and ventilation unit with the fan not powered during the measurements. The Booth was installed for test at two locations within the reverberation chamber over nine 500 x 500 mm carpet tiles arranged in a 3 x 3 array. The two locations were at least 1.7 m apart as required by ISO 23351-1.

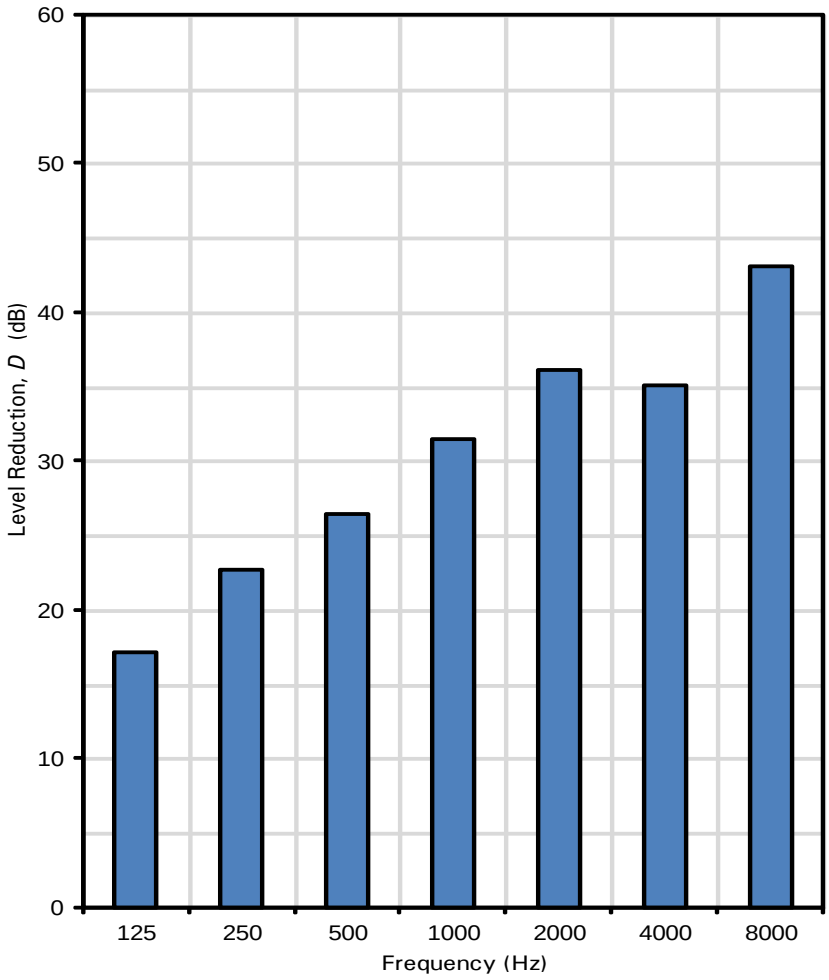
Drawing No. 016 HAW 300 issue 02 (2 pages) on the following pages shows further details, with the following photograph showing BuzziNest Booth installed for test. It is however noted that the Buzzi Milk Stool and telephone shelf were not present in the test.

Speech Level Reduction according to ISO 23351-1:2020

Test No. L/3508 Date of Test: 22 September 2020
Client: Buzzispace
Specimen: BuzziNest Booth

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Reverberant Chamber	204 m³	18°C	75%	1000 hPa

Frequency (Hz)	*D* (dB)
125	17.2
250	22.7
500	26.4
1000	31.4
2000	36.1
4000	35.1
8000	43.1



Rating according to ISO 23351-1:2020

Speech Level Reduction, $D_{S,A}$ = 27.1 dB Class : B

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APPENDIX A1 - METHOD OF MEASUREMENT OF SPEECH LEVEL REDUCTION

A steady sound source with a continuous spectrum in the frequency bands of interest is used to drive an omnidirectional loudspeaker at a height of 1.2 metres inside the booth, which is equivalent to the head height of a seated person.

The Sound Power Levels emitted from the booth are determined according to the method described in Appendix A2.

The measurement process is then repeated with the booth removed but all other conditions equivalent.

The insulation of the booth against airborne sound (Level Reduction) in each octave band is calculated from the following equation:

$$D = L_{W,P,1} - L_{W,P,2} \quad \text{dB}$$

where D is the Level Reduction

$L_{W,P,1}$ is the Sound Power Level radiated from the sound source in the absence of the booth (dB re 1pW)

$L_{W,P,2}$ is the Sound Power Level radiated from the sound source when located inside the booth (dB re 1pW)

The measurements are made for each of 2 booth positions at least 1.7 m apart, with the arithmetic average of the 2 sets of data determined.

The sound power level radiated from the booth in each octave band assuming a standardized sound power level of genderless speech ($L_{W,S,2}$) is determined from:

$$L_{W,S,2} = L_{W,S,1} - D \quad \text{dB re 1pW}$$

where $L_{W,S,2}$ is the sound power level of speech radiated from the booth (dB re 1pW)

$L_{W,S,1}$ is the known standardized sound power level of genderless speech (dB re 1pW)

D is the measured Level Reduction

The single figure Speech Level Reduction ($D_{S,A}$) is determined from :

$$D_{S,A} = L_{W,S,A,1} - L_{W,S,A,2} \quad \text{dB}$$

where $D_{S,A}$ is the Speech Level Reduction (dB)

$L_{W,S,A,1}$ is the A-weighted sound power level of standardized genderless speech (68.4 dB re 1pW)

$L_{W,S,A,2}$ is the A-weighted sound power level of standardized genderless speech radiated from the booth (dB re 1pW)

The Class rating is determined by comparison of the $D_{S,A}$ with the look-up table in Annex D of ISO 23351-1.

APPENDIX A2 – METHOD OF MEASUREMENT OF SOUND POWER LEVEL

The Sound Power Levels emitted by a specimen are measured under reverberant sound conditions by the direct method and in accordance with the requirements of BS EN ISO 3741:2010 (ref 2).

The specimen is installed for test over the floor of a purpose built reverberation chamber. The chamber is constructed of 215 mm brick with a 250 mm thick reinforced concrete floor and ceiling, and has a volume of 212 cubic metres and surface area of 228 square metres. The chamber rests on resilient mountings to give it good acoustical isolation from the building exterior. In order to give a good diffusion of the sound field within the chamber, the walls are non-parallel and eight randomly suspended diffuser panels are included with a surface area of 14.1 square metres.

Whilst the test specimen is operating sound pressure level measurements are made within the chamber in the octave bands with centre frequencies from 125 Hz to 8000 Hz. The measurements are made using a microphone connected to a rotating boom located in two positions within the chamber for each booth/sound source location in order to obtain a good average of the sound pressure level in the chamber may be obtained. Measurements are also made when the sound source is not operating in order to determine the noise floor of the test chamber and measuring system in order that corrections may be made for their influence if applicable.

The Sound Power Level (L_W) of the noise source under test in each octave band is calculated from the following:

$$L_W = L_{p(ST)} + \left\{10\lg \frac{A}{A_0} + 4.34\,\frac{A}{S} + 10\lg\left[1 + \frac{Sc}{8Vf}\right] + C_1 + C_2 - 6\right\} \quad \text{dB re 1pW}$$

where $L_{p(ST)}$ is the mean octave band time-averaged sound pressure level in the reverberation chamber of the specimen under test, corrected for the influence of background noise if appropriate (dB re 20 μPa)

A is the equivalent absorption area (m²) of the reverberation chamber

A_0 is the reference absorption area = 1 m²

	S	is the surface area (m²) of the reverberation chamber
	c	is the speed of sound (m/s)
	V	is the volume (m³) of the reverberation chamber
	f	is the mid-band frequency (Hz) in the appropriate frequency band
	C_1	is the reference quantity correction (dB)
	C_2	is the radiation impedance correction (dB)

The value of 'A' is determined from:

$$A = \frac{55.26}{c}\left(\frac{V}{T_{60}}\right) \quad m^2$$

where T_{60} is the reverberation time (seconds) of the reverberation chamber which is determined from the arithmetic average of twelve measurements.

A3 - REFERENCES

1. International Standard ISO 23351
Acoustics – Measurement of speech level reduction of furniture ensembles and enclosures

ISO 23351:1-2020
Laboratory method

2. International Standard ISO 3741
Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Precision methods for reverberation test rooms

APPENDIX A4 - SCHEDULE OF EQUIPMENT

Use	Type	Serial No.
Measuring System	Nor850 Multi Channel Analyser	8501193
	B&K 4165 Condenser Microphone	1042002
	B&K 2669 Microphone Pre-Amplifier	2221217
	NEAS 265 Rotating Microphone Boom	29465
Calibration	B&K 4228 Pistonphone	1756569
Noise Source	NEAS 223 Dodecahedron Loudspeaker	16251
	HH V-150L Power Amplifier	40545
	MXR 172 Graphic Equaliser	n/a

End of AIRO Report No. L/3508 dated 14 October 2020

AIRO

Report No. L/3513/A

for
Buzzispace
Groeningenlei 141
2550 Kontich
BELGIUM

UKAS TESTING
0483

Dated: 21 December 2020

LABORATORY MEASUREMENTS

OF THE

EQUIVALENT SOUND ABSORPTION AREA

AND

OBJECT SOUND ABSORPTION COEFFICIENT

OF

BUZZINEST BOOTH

Report Author: M Sawyer MIOA

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LABORATORY MEASUREMENTS

OF THE

EQUIVALENT SOUND ABSORPTION AREA

AND

OBJECT SOUND ABSORPTION COEFFICIENT

OF

BUZZINEST BOOTH

1. INTRODUCTION

This report presents the results of measurements made in the AIRO Acoustics Laboratory of the sound absorption of the external surfaces of BuzziNest Booth.

The measurements were made on 10 December 2020 for Buzzispace.

Measurements of sound absorption, Equivalent Sound Absorption Area (A_{obj}), were conducted in accordance with International Standard ISO 354 (ref 1). Octave band values of Object Sound Absorption Coefficient (α_{obj}) are derived from these measurements in accordance with International Standard ISO 20189 (ref 2).

AIRO is a UKAS accredited testing laboratory No. 0483 with measurements to International Standard ISO 354 included on our schedule of accreditation. International Standard ISO 20189 is not however included on our UKAS schedule of accreditation. UKAS is the United Kingdom Accreditation Service.

2. SUMMARY OF RESULTS

The following table presents a summary of the measurements included in this report.

AIRO Test No.	Test Specimen
L/3513/A	BuzziNest Booth

Approved by:

D L Watts

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Principal Consultant

Report Author:

M Sawyer

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Laboratory Manager

3. TEST SPECIMEN DETAILS AND CONDITIONS

It shall be noted that the results in this report relate only to the specimen as received for test.

The specimen was delivered and installed for test by Screen Solutions Ltd on 10 December 2020. AIRO has had no involvement in the selection of the specimen or the components which make-up the specimen.

Screen Solutions Ltd has supplied drawings of the test specimen which AIRO considers to be accurate. The following description has been produced by AIRO from its observations.

3.1 BuzziNest Booth

AIRO Test No. L/3513/A

The test specimen comprised a BuzziNest Booth telephone privacy pod. The fabric covered BuzziNest Booth, with external dimensions of 1098 mm wide x 1046 mm deep x 2177 mm high, and a footprint of 1007 mm wide x 1046 mm deep, comprised a timber famed construction with internal and external sound absorbent panels. The front wall comprised an 8.8 mm acoustic laminate glass door with a magnetic latch which closed onto a soft seal. The rear wall of the Booth also comprised 8.8 mm acoustic laminate glass. The Booth was fully fitted-out except for the telephone shelf and milk stool. The Booth also included a ceiling mounted lighting and ventilation unit with fan which was not powered during the measurements. As required by ISO 20189 the Booth was tested at three locations within the reverberation chamber which were at least 2 m apart.

The calculated surface area of the smallest cuboid (excluding the base) of the specimen is 10.48 m².

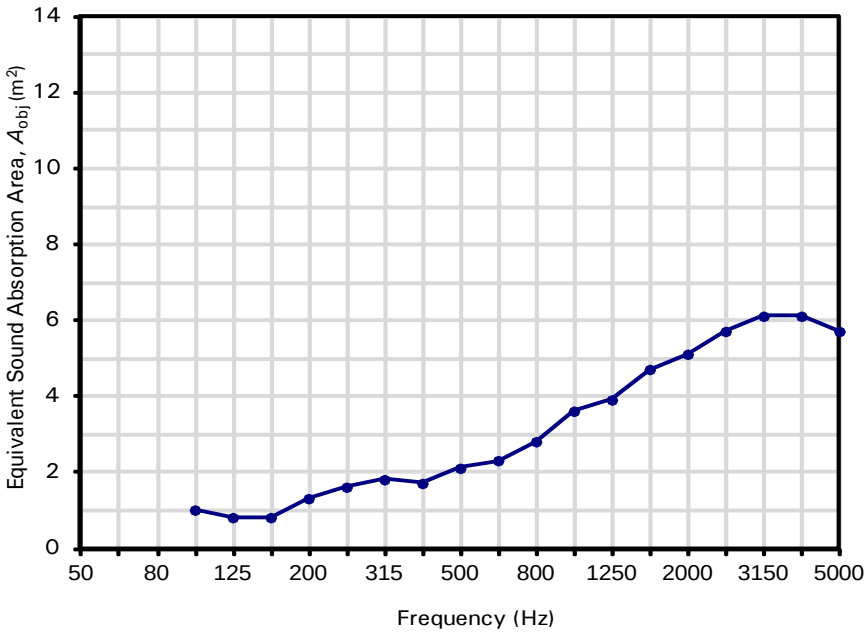
Drawing No. 016 HAW 300 issue 02 (2 pages) on the following pages shows further details, with the following photograph showing BuzziNest Booth installed for test.

Equivalent Sound Absorption Area according to ISO 354:2003

Test No. L/3513/A Date of Test: 10 December 2020
Client: Buzzispace
Specimen: BuzziNest Pod

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m³	8°C	75%	985 hPa
Chamber with Specimen	221 m³	8°C	75%	985 hPa

Frequency (Hz)	A_{obj} One-third Octave (m^2)	α_{obj} Octave *
50		
63		
80		
100	1.0	
125	0.8	0.10
160	0.8	
200	1.3	
250	1.6	0.15
315	1.8	
400	1.7	
500	2.1	0.20
630	2.3	
800	2.8	
1000	3.6	0.30
1250	3.9	
1600	4.7	
2000	5.1	0.50
2500	5.7	
3150	6.1	
4000	6.1	0.55
5000	5.7	
6300		
8000		
10000		



See Appendix A5 for Reverberation Times of Empty Chamber and Chamber with Specimen

* ISO 20189:2018 and α_{obj} are not included on our UKAS schedule of accreditation.

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Laboratory Manager

APPENDIX A1 - METHOD OF MEASUREMENT TO ISO 354:2003

The sound absorption of a specimen is measured under diffuse field conditions where sound is incident upon the specimen from all directions.

The specimen is installed directly over the floor of a purpose built reverberation chamber. The chamber is constructed of 215 mm brick with a 250 mm thick reinforced concrete floor and ceiling and has a volume of 221 cubic metres and surface area of 225 square metres. The chamber rests on resilient mountings to give it good acoustical isolation from the building exterior. In order to give a good diffusion of the sound field, the walls are non-parallel, the ceiling pitched and twenty randomly suspended diffuser panels are included with a surface area of 37.2 square metres.

A steady sound source with a continuous spectrum in the frequency bands of interest is used to drive an omnidirectional loudspeaker which is located in the chamber. The reverberation times of the chamber are determined using the interrupted noise method with three decay measurements made at each of four microphone positions for each of three loudspeaker positions to obtain a good average at each of the one-third octave intervals from 100 Hz to 5000 Hz as prescribed in the Standard (ref 1). The test is conducted with the specimen installed within the chamber, and also in the absence of the specimen and any associated framework. Where only one example of the specimen is available then the measurements are made with the specimen in three locations.

The Equivalent Sound Absorption Area (A_{obj}) of the specimen is calculated using the following formula:

$$A_{obj} = 55.3\frac{V}{n}\left(\frac{1}{c_2 T_2} - \frac{1}{c_1 T_1}\right) - 4V(m_2 - m_1) \qquad \text{Equation (i)}$$

where: V is the volume of the empty reverberation chamber (m³)

n is the number of discrete objects

T_1 is the mean reverberation time of the empty reverberation chamber (seconds)

T_2 is the mean reverberation time of the reverberation chamber with the test specimen installed (seconds)

m_1 and m_2 are the power attenuation coefficient at T_1 and T_2 calculated according to ISO 9613:1993 (ref 3)

c_1 and c_2 are the velocity of sound calculated from the following formula:

$$c = 331 + 0.6t \quad \text{m/s} \qquad \text{Equation (ii)}$$

where: t is the air temperature of the reverberation chamber (Celsius)

Octave band values of Equivalent Sound Absorption Area (A_{obj}) are calculated from the one-third octave results in accordance with International Standard ISO 20189 (ref 2) and hence octave band values of Object Sound Absorption Coefficient (A_{obj}) are determined from the following formula:

$$\alpha_{obj} = A_{obj}/S$$

where: A_{obj} is the octave band Equivalent Sound Absorption Area (m²)

S is the total exposed surface area of the smallest cuboid of the object in the laboratory measurement for the actual mounting condition (m²)

The calibration of all equipment is traceable via an unbroken chain to National Standards.

APPENDIX A2 - PRACTICAL APPLICATION OF TEST RESULTS

The Equivalent Sound Absorption Area and Object Sound Absorption Coefficient are absolute physical constants of a material, however their effect upon the acoustic environment will be influenced by the method of mounting and the distribution of the material or system within a space.

APPENDIX A3 - REFERENCES

1. International Standard ISO 354:2003
Acoustics - Measurement of sound absorption in a reverberation room

2. International Standard ISO 20189:2018
Acoustics – Screens, furniture and single objects intended for interior use – Rating of sound absorption and sound reduction of elements based on laboratory measurements

3. International Standard ISO 9613
Acoustics - Attenuation of sound during propagation outdoors

ISO 9613-1:1993
Calculation of the absorption of sound by the atmosphere

APPENDIX A4 - SCHEDULE OF EQUIPMENT

Use	Type	Serial No.
Measuring System	Nor850 Multi Channel Analyser	8501193
	B&K 4165 ½" Condenser Microphone	1042002
	B&K 4165 ½" Condenser Microphone	1471398
	B&K 2669 Microphone Pre-Amplifier	1856926
	B&K 2669 Microphone Pre-Amplifier	2221217
Calibration	B&K 4228 Pistonphone	1704324

APPENDIX A5 - MEAN REVERBERATION TIMES

Frequency Hz	Mean Reverberation Times, secs	
	Empty Chamber	Chamber with Test Specimen
100	8.42	6.89
125	6.89	6.02
160	5.71	5.05
200	5.81	4.78
250	6.21	4.91
315	6.86	5.14
400	7.01	5.28
500	7.08	5.04
630	7.13	4.89
800	7.00	4.53
1000	6.82	4.06
1250	6.26	3.74
1600	5.65	3.28
2000	5.00	2.93
2500	4.08	2.49
3150	3.26	2.11
4000	2.73	1.87
5000	1.93	1.48

End of AIRO Report No. L/3513/A dated 21 December 2020